Regional HOT Lanes Network Feasibility Study

Phase 2, Task 12

PHASED HOT LANE

DEVELOPMENT PROCESS

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and

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Introduction

As with most large infrastructure systems, a Bay Area regional HOT lane network will be developed over time, will need to consider various organizations' and users' needs and requirements, and will need to both create opportunities and take advantage of opportunities offered by others. This working paper reviews the process for moving from today's HOV system to a fully integrated network of HOT lanes.

Key elements considered include:

- Phasing strategies
- Physical improvements and linkages
- Costs, including capital, operations and maintenance, centralized services, and financing
- Environmental needs and concerns
- Project development requirements and processes, particularly those of Caltrans and FHWA
- Overall schedule of activities

Background

A key element of the MTC Regional HOT Lanes Network Feasibility Study is the staging or sequencing of HOT lane development. In Phase 1, two networks were examined as if they were completed in two stages, each occurring in a single year. For an initial assessment, that provided useful insight. However, to understand the likely staging, financial, and project development needs more clearly, it is important to consider both the factors which would influence the sequence of HOT lane development and the implications of applying those factors.

MTC's consideration of a regional HOT lane network as has led to the conclusion that a regional network is feasible, can help improve traffic management, can be self-funding, and can help generate revenue to pay for other regional transportation needs. Among the key issues to be explored is what it will take to develop such a network both in terms of organizational roles and resources. The approximately 800 lane miles of HOT lanes will require several key actions, some of which can be delivered using traditional means and some of which offer opportunities for innovation. HOT lanes, themselves, require innovation in project development, delivery, and operations because there is relatively little experience with them in the Bay Area, in particular, or in the Bay Area or California, in general.

Phasing strategies

The Bay Area has several conditions and features that frame the next steps for a HOT lane system. These are listed in table 1 on the following page.

Taken together, these elements provide opportunities to upgrade existing HOV lane to add HOT lane features. In addition, the region's experience with HOV lane volumes, traffic flow, and incidents offer valuable lessons on how to design the HOT lane features. In addition, the topic of HOT lanes is not new to the Bay Area. Several elected officials and agencies have an understanding of what a HOT lane is and how it may be useful. What these features do suggest is that the region can begin with HOV lanes in place today and learn from the HOT lane demonstration projects as has been done in this MTC review. HOT lane designs and costing considered by ACCMA and VTA have helped frame the MTC approach.

As has been true of highway and transit development over time, financial feasibility, local acceptance, project readiness, and provision of valued benefits are keys to success. In the case of HOT lanes, their interaction with HOV lane functioning and their effects on freeway traffic flow present important considerations. In particular, the need to maintain useful functioning of HOV lanes is critical.

Among the benefits sought from application of HOT lanes are improving mobility in the region, providing funding for ancillary improvements (e.g., added transit service), and principally, as stated in the MTC objective for considering HOT lanes, maximizing the value of (travel) time saved for all travelers.

Table 1: Conditions Affecting HOT Lane Development in the Bay Area

Conditions and Features Affecting HOT Lanes Development	Implication for HOT Lane Development
Existing HOV network	• HOV lanes are in place and, in many cases, can be upgraded to a HOT lane at less cost than would be required by adding a new HOV lane
Additional HOV lanes are planned in the RTP	• There is regional consensus for added HOV lanes and, in some cases, committed funding for the added HOV lanes
HOT lanes are being developed by ACCMA and VTA	• There is a commitment to demonstrating HOT lanes in some portions of the Bay Area • Stakeholders in other parts of the Bay Area can learn from these experiences
Capabilities and experience with the Bay Area Toll Authority	• The Bay Area has experience with tolling, revenue collection, toll administration, and prioritization of revenue usage
Legislative support for the VTA and ACCMA HOT lane demonstration projects	• The California legislature has demonstrated support for the demonstration projects. • Key initial issues needing to be resolved for HOT lane development are generally understood
California experience with SR 91 and I-15	• HOT lane development and operation are not new to California. • The Bay Area can learn from the SR 91 and I-15 experience.

Mobility can be considered in light of added travel choices and in reduction in congestion. The HOT lanes' effect on HOV and general purpose travel lane speeds can be considered here. In addition, to the extent that HOT lanes produce more revenue than it costs to develop and operate them, the region may be able to add transit services and make other investments which will result in improved mobility.

Maximizing the value of time saved for all travelers is represented in the HOT lane assessments completed to date by the revenue estimated to be generated by the tolling. Implicitly, the forecasting conducted to date suggests that the more revenue generated, the more users are receiving valuable travel time savings. (Otherwise, the users would not pay the tolls to the degree suggested by the forecasting.)

Geographic Groupings of HOT Lane Projects

In review of potential HOT lanes, that there are five groupings where decisions about sequencing or staging need be considered in terms of their effects on other projects. These groupings are listed in table 2 on the following page. Overall staging of HOT lanes can have an effect on regional revenue availability for other investments in the region but that consideration will be brought into the review on the basis of overall cash flow (i.e., which projects can generate sufficient funds to help deliver the overall program earlier and more reliably bearing in mind the primacy of maintaining the value and effectiveness of the HOV lanes).

For example, decisions about timing for add tolling features on I-680 need to take into account the demonstration project in the Sunol Grade area. However, the timing of projects in Marin County has no immediate effect on I-680-related projects (other than in terms of overall regional cash flow and availability of time and resources for project development.)

Table 2: Geographic Groupings of HOT Lane Corridors

Associated with I-680	Santa Clara/ San Mateo	Associated with I-80	Marin-Sonoma	Associated with I-880
I-680 from I-80 to US 101 **SR 4** **I-580**	**US 101 SM/SC** **SR 85** **SR 87** **SR 237** **I-280** **I-880 from SR 237 to US 101**	**I-80 from Bay Bridge to Yolo Co Line**	**US 101 in Marin and Sonoma**	**I-880 from Oakland to SR 237** **SR 84** **SR 92**

<u>HOT Lane Sequencing Principles</u>

In an ideal circumstance, the highest priority HOT lanes would be those that have the greatest potential benefit, the greatest benefit to cost ratio, and the least implementation concerns.

Project readiness, HOV interactions, and other factors must also be considered. Four HOT lanes are in project development (two in Alameda County and two in Santa Clara County). Clearly, these will be ready to implement sooner than those for which no project development has been undertaken.

In some cases, HOV lanes already exist or are committed to be funded from sources other than HOT lane revenues. Those have fewer development or financial hurdles and can be seen as being implemented earlier than ones where no HOV lane exists or where the HOV element may need to be funded from tolling revenues.

Given those opportunities and constraints, the following principles have been developed to guide HOT lane sequencing in further refinement of the regional HOT lane program. The principles reviewed in Table 3 on the following page are intended to serve as general guidance and not as a prioritized list. These were used as general guidance in developing the HOT lane sequencing scenario represented in the Phase 2 HOT lane working papers.

Appendix 1 presents the phasing of HOT lane corridor implementation using the principles referred to above. The HOT lanes considered in Phase 1 and 2 are listed by the five year period in which the tolling function was assumed to begin. Also listed are the HOV occupancy levels for each corridor including what HOV occupancy they begin tolling at and what year the HOV occupancy would need to increase to account for congestion from high occupancy vehicles.

Physical Improvements and Linkages

The physical corridor improvements needed to support the HOT function will need further definition before MTC and its partners will have an agreed-upon design standard. At this point, the idealized design approach calls for a HOT lane of at least 11 feet, a painted buffer of 4 feet, and a median shoulder of 14 feet (that can be used as a breakdown and enforcement area for most of the corridor and can be used to create the merge and weave lane space for HOT lane ingress and egress sites).

In the Phase 1 and 2 corridor reviews, it is clear that this design approach can not be realized in all segments of the 790 lane miles under consideration.

In future reviews, it will be important to refine the cost estimates for this idealized design approach as well as consider the implications of using a less costly design approach (involving less space for buffers and shoulders).

Key freeway-to-freeway connectors are considered in the costing of the HOT lane program. These connectors will be needed to enable the HOV lanes on freeways to provide continuity from one corridor to intersecting ones. These HOV connectors are costly and can be expected to provide significant HOV benefits (and HOT benefits).

Table 3: Recommended Principles for HOT Lane Sequencing

Principles for HOT Lane Development Sequence (Not in priority order)	Examples of Corridors Covered by This Principle
Begin with demonstration projects in development today	ALA - SC I-680 SB (SR 84 to Calaveras) ALA I-580 EB SC US 101 SC SR 85
Ease of implementation (e.g. conversion of existing HOV lanes; corridors where more right-of-way is available and/or freeway is designed to more recent standards)	SCL SR 85
Look for opportunities to incorporate HOT lane features in related corridor projects (e.g. a freeway or structure rehabilitation project)	No specific corridor identified at this point. Topic will need further review Need to recognize these as "tipping point" opportunities that may suggest earlier or later starting dates depending on the nature of the related project

Table 3 (Continued: **Principles for HOT Lane Development Sequence (Not in priority order)**	**Examples of Corridors Covered by This Principle**
Do not begin HOT lane operation with less than five years before an HOV lane's vehicle occupancy will need to be increased	CC I-680 reaches HOV threshold in 2020 in SB direction in a.m. peak; HOV occupancy would need to increase to 3+ then; HOT lane should not begin operation prior to 2020[1] SC SR 87 reaches HOV threshold in 2040; HOT lane can begin operation at 2+ earlier (2020)
Emphasize corridors where user benefits are clearer	SC US 101 ALA I-580 ALA CC NAPA SOL I-80 ALA I-880
Build on or add to demonstration projects	ALA I-680 NB (SR 84 to SCL County line) ALA I-580 WB

[1] Assumes phased implementation for all corridors except four demonstration projects begins no sooner than 2015.

Table 3 (Continued) Principles for HOT Lane Development Sequence (Not in priority order)	Examples of Corridors Covered by This Principle
Consider traffic operations and safety issues	No specific corridors identified
Fill gaps	CC 680 NB through Walnut Creek ALA CC 680 SR 84 to Alcosta SC I-880 (SR 237 to US 101)
Extensions of corridors	SON US 101 (northern segment) SC US 101 (Cochrane to SR 25) SOL I-80 (SR 37 to Yolo Co Line)
Consider benefits to transit and shared ride travel	Corridor reviews need to consider the extent to which HOT lane applications can help support transit services and shared ride travel
Consider operational benefits	Corridor reviews need to consider the extent to which projects create or ease bottlenecks in the HOT and general purpose lanes
Seek geographic equity (see geographic groupings of HOT lane projects in preceding section)	Probably preferable to advance portions of each sub-area network is such a fashion that no part of the region is left far behind the others.

The connectors considered as part of the HOT-funded network are:

- SR 4/I-680 HOV Connector -- $75 million (estimate from Caltrans)
- I-580/I-680 HOV Connector -- $325 million (estimate from Caltrans)
- I-80/I-680 HOV Connector -- $115 million (high range estimate from design consultant)

<u>HOT Lane System Revenues and Costs</u>

HOT lane revenues were forecast using a conservative approach (meaning that future refined estimates should estimate at least as much revenue as presented here). The revenue estimate basis is reviewed in an accompanying working paper (Task 3 Report).

HOT lane costs were developed based on updated capital costs:

- HOT lane unit costs are 20% higher than the costs reflected in Phase 1 to reflect additional contingency;
- HOV costs are the same;
- O&M and centralized costs are the same as applied in Phase 1; and,
- financing costs are now included (see Table 4c)

The costs by five year period through 2035 are shown in table 4a on. These include capital, operations and maintenance, and centralized services (with the last two categories combined). Financing costs are not shown in table 4a but are introduced in tables 4b and 4c. The resulting net revenues are presented based on the forecast (taken as a high range and listed in table 4b) and a low estimated (reducing the forecast revenue by 30% and presented in table 4c). Using the forecast revenues and the estimated costs (the high range), the phasing scenario suggests that the HOT lane network can pay for itself and have a positive cash balance of $3.6 billion by 2035. Note that debt financing continues past 2035 and, although not shown in the table, net revenues continue to grow past 2035.

Assuming 30% less revenue (as shown in table 4c below), the HOT lane network pays for itself (a net revenue very close to zero should be seen as suggesting that the system essentially covers its own costs). As in the preceding case, debt financing continues past 2035 and net revenues continue to grow past 2035.

Table 4a: HOT Lane Network Costs (except for “debt service” costs) by Period – 2015 to 2035

	Pre-2015	2015-19	2020-24	2025-29	2030-35	Total
Capital	$ (0.8)	$ (1.5)	$ (2.5)	$ -	$ -	$ (4.8)
O&M + Cent Svc	$ -	$ (0.2)	$ (0.3)	$ (0.5)	$ (0.6)	$ (1.6)
Total	**$ (0.8)**	**$ (1.7)**	**$ (2.8)**	**$ (0.5)**	**$ (0.6)**	**$ (6.4)**

Table 4b: HOT Lane Network Revenues (as forecast) and Costs by Period – 2015 to 2035

(Note that capital costs are paid by borrowed funds and ”debt service” costs account for payment of capital.)

	Pre-2015	2015-19	2020-24	2025-29	2030-35	Total
Revenue	$ -	$ 0.8	$ 1.8	$ 3.1	$ 5.7	$11.4
O&M + Cent Svc	$ -	$ (0.2)	$ (0.3)	$ (0.5)	$ (0.6)	$ (1.6)
Debt Service	$ -	$ (1.5)	$ (1.5)	$ (1.5)	$ (1.8)	$ (6.3)
Total	**$ -**	**$ (0.9)**	**$ 0.0**	**$ 1.1**	**$ 3.3**	**$ 3.5**

Note: This table includes revenues as forecast (and does not represent the lower end of the revenue range).

Table 4c: HOT Lane Network Revenues (low range estimate) and Costs by Period – 2015 to 2035

(Note that capital costs are paid by borrowed funds and "debt service" costs account for payment of capital.)

	Pre-2015	2015-19	2020-24	2025-29	2030-35	Total
Revenue	$ -	$ 0.5	$ 1.3	$ 2.2	$ 4.0	$ 8.0
O&M + Cent Svc	$ -	$ (0.2)	$ (0.3)	$ (0.5)	$ (0.6)	$ (1.6)
Debt Service	$ -	$ (1.5)	$ (1.5)	$ (1.5)	$ (1.8)	$ (6.3)
Total	**$ -**	**$ (1.2)**	**$ (0.5)**	**$ 0.2**	**$ 1.6**	**$ (0.1)**

Note: This table includes revenues 30% lower than forecast for this review. This represents a low range estimate.

Environmental Needs and Concerns

As with all infrastructure system development, there will be environmental issues to address in further development of the HOT lane system concept. Because the HOT lanes involve federally-funded facilities and will involve FHWA decisions, some form of demonstrated compliance with the National Environmental Policy Act will be required (whether that is satisfied by a categorical exemption or other classification of NEPA document).

The California Environmental Quality Act requirements will also need to be addressed, most likely in the same process that addresses NEPA requirements.

MTC and Caltrans will need to make a determination (in consultation with FHWA) about the likely environmental issues and the most appropriate means of addressing them. Some topics likely to be considered include:

- Environmental justice (whether all groups' needs and impacts have been considered and whether any particular groups bear a disproportionate share of the impacts or gain a disproportionate share of the benefits)
- Whether and to what degree there may be growth inducement
- Effect on emissions (particularly noting that peak period vehicle hours of travel are likely to be affected by the use of HOT lanes)

NEPA and CEQA, depending on how the requirements are addressed, will lead to consideration of a wider range of issues than the few listed above.

Project Development Requirements and Process

High occupancy toll (HOT) lane phasing and development can respond to various factors, including the current actions being taken on HOT demonstrations, potential to parlay development based on projects in the "pipeline" for implementation, optimizing development based on potential to address demand in the corridors generating greatest benefit, and potential to tap into revenues at the earliest opportunity to address cost recovery through available revenue. This working paper examines a phasing scenario that would enable all HOT lanes to be in place by 2025 and evaluates demand, revenue and costs associated with these scenarios. This working paper also briefly addresses the planning and design process, and design guidance applied for standards associated with HOT lanes generated from steering committee meetings.

Planning and Design Process -- As outlined in a companion working paper (Task 13 Report) addressing governance, the HOT lane planning process mirrors any other highway project. It primarily involves MTC, local partnering agencies, Caltrans and the Federal Highway Administration. Caltrans has lead responsibility for approval of design and construction of any roadway improvements in state owned right-of-way, and FHWA must review and approve of any planned improvements, during the project planning, development, and design processes.

State guidelines and standards of practice are applied for such improvements, and in many cases FHWA program guidance also must be taken into account for issues specific to HOV and HOT lanes. There is a very prescriptive project development process required for the phases of preliminary engineering, environmental review and design. These are specified in the Caltrans Project Development Program Manual (PDPM) in Chapter 9. Unique project development issues relate to installation of pricing equipment and related signing and telecommunication on the roadway and the agency that will have responsibility for managing toll accounts, which could be BATA or local county transportation agencies. Typically such installations are handled via separate design packages subject to review and construction management of Caltrans.

In addition to the PDPM, the primary resource specific to HOV and HOT lanes is the Caltrans HOV Guidelines, latest edition, as amended. While these guidelines do not specifically address HOT lane pricing and signing, most of the design treatments related to lane and shoulder widths, access treatments and enforcement provisions contained in this guide are appropriate. The guidelines are intentionally broad to cover different design treatments found in northern and southern California.

The project development process involves the steps listed below, which may be performed sequentially or concurrently with some risk associated in this latter approach if significant changes occur in the proposed alternative design treatment and its impacts or operation approach.

Project Study Report (PSR): The primary purpose of the PSR is to develop the project sufficiently to prepare a scope and cost for the proposed improvements including cross sections, layouts of key design and related features. Design exceptions and assumptions associated with them are also included, and if extensive, may involve a Fact Sheet which stipulates the exception, why it is required and the cost to otherwise address. PSRs are used for programming and budgeting purposes. A question raised during the feasibility of this study is the potential for a programmatic PSR to address the entire HOT lane network. While such a study and document may help confirm development costs for a specific approach to implementation, there's been limited precedent for this approach, but it appears possible so long as the PDPM requirements in Chapter 9 are addressed. The potential still exists that a separate PSR might be required if the project scope grows substantially for a given segment or subregion.

Project Report (PR)/Environmental Review: The PR involves preliminary engineering and confirms both the intended design and other project details needed for environmental review and approval. Typically where HOT lane improvements are contained within the highway right-of-way, requirements associated with an Environmental Assessment (EA) are appropriate.

Final Roadway Design: The HOT lane improvements to the roadway are performed in final design packages that preferably are segmented such that the greatest benefits can be provided without creating artificial (temporary) traffic bottlenecks at the downstream termini. Staging of design packages becomes critical in setting the scope for each, and in handling any substructure components of the systems engineering (pricing and signing) work. Typically systems engineering is separated constructed because the differences in roadwork and pricing involve different construction disciplines and expertise, and better contract bids are often achieved unless the roadway design improvements are quite modest.

Systems Engineering: Design for the HOT pricing system to be employed on the HOT lanes. Some design elements, notably substructures for sign pedestals, conduit runs and such should be incorporated in to the final roadway design. Performance of systems engineering may take the form of a conventional design-bid-build sequence, design/build in which both design and construction happen simultaneously during roadway construction, or design-build-operate-maintain (DBOM) in which the systems engineer is also responsible for operations and perhaps maintenance of the system for a pre-determined period. The DBOM for systems may be supportive to BATA or a contractor to BATA.

Bid/Construct: Typically the roadway and/or systems engineering design is bid and awarded for construction. The variance in construction time mirrors the level scope of work, extending from three to six months for modest restriping, signing and upgrading of existing pavement to two to four years for widening or corridor rebuilding. Often the dictate for the construction period is the number of phases of work necessitated to handle the same number of lanes of traffic, which is a condition required for most all Bay Area freeways.

Caltrans and FHWA review will be involved for each phase of project development.

Funding – As with any highway project, funding for new HOT lanes or enhancements and modifications to existing HOV lanes can involve a variety of state, federal and local sources. HOV projects currently programmed with funding from these sources may need to be updated to cover the added costs associated with HOT lanes. In early years of development, the added costs of funding HOT lanes may come from bonds pledged from local funding sources or future HOT lane forecasted revenue as determined from a project-specific or network Traffic and Revenue (T&R) study. In future years, revenue from HOT lanes may cover a portion or all of the added costs for system build-out, depending on the pace of project development and preferred phasing involved.

Design Guidance – While a wide variety of HOT lane design approaches have been applied nationally, only a limited subset of this experience is related to the Bay Area. Of the seven HOT lanes implemented to date, all but I-394 in Minneapolis are separated from adjacent traffic by concrete barriers or plastic traffic delineators (and much of I-394 is reversible flow with barrier separation as well). This means that there is limited operating experience with HOT pricing on concurrent HOV lanes, whether they be operating 24/7 or part-time. And, no HOT project has been implemented to date involving the constrained design setting found on many HOV lanes in the Bay Area.

The I-394 Minneapolis HOV lanes opened as part of a completely new freeway in 1984, involving full lane and shoulder widths, with standard freeway ramps employing the latest high-speed designs for merges, weaves and transitions at interchanges. While there will be HOT lane projects implemented in the near future on older generation freeways (i.e., SR 167 in Puget Sound and Loop 1 in Austin), operation experience from these projects will not be known for some time. Standards of practice for implementing HOV lanes in California have been known for at least 15 years. Parallel practice will take time to evolve for HOT lanes. Risk factors which could affect HOT lane design guidance looking forward include the following:

Designated access treatments on HOV may increase accident rates over continuous access designs, but pricing installations can more effectively safeguard violations if they are placed within toll zones that are substantially segregated from adjacent lanes through some form of access control.

CHP does not have experience in monitoring a concurrent traffic stream composed of free and paid users except in barriered environments. Standards of enforcement practice may have to be tested before a specific design is found safe and workable. Dedicated enforcement areas, in lieu of continuous shoulders, may or may not be as effective for high volumes of traffic flow.

Higher traffic volumes may dictate more attention to direct access treatments, which will affect overall project cost. Where project termini occur, new bottlenecks may result without the addition of auxiliary lanes to facilitate downstream merging, even if these conditions are temporary.

Experience with the application of traffic channelizers, if they are employed to substantially separate traffic, is limited and has not been applied on a systemwide basis. The costs for replacements may prove expensive and hazardous to maintenance personnel.

Part-time and full-time operation experience seems to have worked well in northern and southern California. Aside from the revenue implications, there is no proven experience yet to suggest one approach is better than the other for higher HOT traffic volumes.

Preserving reliability will be critical to protecting the benefits, demand and revenue stream for HOT lanes. Yet, reliability can be compromised if breakdown shoulders are not available next to HOT lanes and minor incidents disrupt or block the lane. Most recently throughout southern California HOV lane volumes and flow rates have deteriorated due to high flow rates and incidents. HOT lanes must operate better, and the ability to do so will be affected in part by the design afforded.

Signing concepts required to communicate complex pricing strategies for sequential access locations have limited use to date, and benefits provided are not yet communicated to users (but will be soon). Preferred communication strategies will likely emerge, but are not yet known. Guidance will evolve over time and eventually be instituted in the national Manual for Uniform Traffic Control Devices, which Caltrans has adopted.

FHWA's HOT Lane Guide and design experience from current HOV and HOT lanes offer the best resources at present until more HOT projects are opened.

Preferred Design –While design standards for HOT lanes in California are not documented, the HOT steering committee for this study offered the following guidance:

Lane Width: 12 feet

Median Shoulder: 14 feet (for breakdowns and enforcement)

Buffer: 4 feet between HOT and adjacent lanes

Access: Transition lanes between the HOT and adjacent lanes

Access Frequency: Separate ingress and egress lanes with spacing frequency to comply with the Caltrans HOV Guide to minimize and control merge and weave maneuvers

Toll Signing: At least one cantilever sign over each ingress location posting toll rates.

Guide Signing: Cantilever mount over each major HOT direct access ramp and HOT mainlane (must be compliant with latest FHWA program guidance)

Transponder: Must be Title 21 compliant with other electronic toll applications in the State.

Current Local and Statewide Design Practice -- HOV lanes currently exhibit a wide range of design practice statewide. Lane widths vary from 12 feet to 11 feet in restricted settings. Buffer widths are typically 4 feet, but may be reduced to 1 to 2 feet in restricted settings. Median shoulder widths vary from nominally 10 feet to 4 feet, but outside (right) shoulders on most freeways are 8 to 10 feet even in restricted settings. General purpose lane widths may be reduced to 11 feet, but the rightmost lane(s) are typically 12 feet in restricted settings. The Caltrans HOV Guide offers guidance for design reductions in such settings.

Restricted settings typically involve freeways which have been widened up to the existing right-of-way or sound walls which are located beyond the edge of pavement. Bridge columns on older structures also represent isolated impediments in which design exceptions may be required for limited distances transitioning into and out of these locations. Overall statewide experience suggests that some of these design exceptions are typically found on all but the newest freeways which have been built or rebuilt within the past 20 years. Design exceptions are often granted for a limited period of time until the exception can be addressed as part of other programmed freeway enhancements. This basis is exemplified on such routes as SR 55 in Orange County, which opened an HOV lane in 1985 reflecting a minimal section; and full standards were regained along this route in successive reconstruction projects from 1990 through 2000.

Next Steps

MTC and its partner organizations will need to continue to work together to refine a phasing plan for each of the subregions developed in this study.

More work will be needed to resolve standards of design practice which can be tailored to both the HOT network and specific corridors. HOV implementation experience over the past 20+ years indicates that one approach to design has not fit all settings. Indeed, Caltrans guidance offers clarity for how to effectively trade-off design attributes in restricted settings. HOT trade-offs will need to go beyond current Caltrans HOV trade-off guidance because of different user mix, the increased volume of traffic and to communicate more information to users. The current HOT demonstrations on several Bay Area freeways will help in the adoption of formal and informal local and statewide standards of practice over time.

In the meantime, closer scrutiny is needed of corridor-specific design issues in meeting the preferred and more limited design treatment reflecting current HOV lane experience. More limited design treatment may only be acceptable as an interim solution for restricted settings. These next steps may be taken as a follow-on activity to the current feasibility study, leading up to the development of PSRs.

Similarly, MTC and its partners need to monitor how project development on other HOT lanes (outside the Bay Area) proceeds. Experience from other roadway and toll road projects implemented statewide suggests that this process can be streamlined under a variety of scenarios. A next step would be identifying and evaluating the merits of these approaches to speed delivery in a coordinated fashion.

Schedule of Activities

As noted above, there are several factors that will affect the project development and delivery schedule. Assuming agreement amongst the key partners (particularly including MTC, Caltrans and the congestion management agencies), it is feasible to accomplish the HOT lane development schedule described in the phasing scenario considered for this working paper. However, that will require each organization to move through the project development process more quickly than has traditionally been the case.

Caltrans District 04 identified probable time requirements for projects involving the addition of both an HOV lane and HOT lane features of six to eight years for environmental review and design plus another four to five years for construction engineering. Projects involving addition of HOT lane features to an existing HOV lane can be accomplished in less time.

An approach that has been helpful in other large program delivery efforts can be described as program management operating with secunded staff (paid for from project funds). By collocating the needed staff and dedicating them to a 100% focus on planning, environmental clearance, design, and construction management, the time from concept to opening day can be reduced. However, that will require a significant level of collaboration as well as clarity on process, design standards, and related topics.

The Caltrans-suggested time period of 10 to 13 years for steps leading up to opening a new HOV and HOT lane needs to be a subject of review between MTC and Caltrans. Clearly, if the upgrades of HOV lanes can be taken to opening day in 5 to 7 years and the more challenging concurrent development of HOV and HOT lanes together take 10 to 13 years, the project schedule considered in Phase 2 could be met.

All HOT lanes to be open by 2015 are in corridors where HOV lanes exist now or will exist by then. With eight years between now and 2015, the schedule would be tight but could be accomplished assuming strong agreement.

All HOT lanes that involve development of the HOV lane features are listed as opening in 2020 or later. With thirteen years between now and 2020, the schedule suggested by Caltrans may be workable. However, there is little room for unknowns or unexpected circumstances in that timing.

It is in MTC's, Caltrans', and the CMA's interests to develop a delivery program that achieves the responsibilities of the involved organizations and does so in less time than such processes typically take. The program management approach described above offers an opportunity to shorten the schedule. However, being able to move through project development more quickly requires several actions including those listed in table 6 on the following page.

It is premature to specify an implementation schedule. However, the following key dates appear important to consider at this point.

- 2008
    - Refined HOT lane development concept and plan
    - Agreement on project development approach

    - Agreement on HOT lane design guidance
    - Agreement on how to finance start-up and management of HOT lane coordinated, collaborative project development process, referred to here as “HOT Lane Program Management.”
    - Agreement on roles and responsibilities for agencies participating in the HOT Lane Program Management organization.
    - Legislative action on items needed to enable development of the overall program
- 2009
    - Investment grade revenue forecast
    - Formation of HOT Lane Program Management organization
    - Begin project development for HOT lanes needing to be in place by 2015 (in addition to the demonstration HOT lane projects)
    - Initiate bonding process
- 2010 to 2015
    - Further project development, environmental clearance, design, and construction for HOT lanes planned to be in place in 2015
- 2010 to 2020
    - Project development, environmental clearance, design, and construction for HOT lanes planned to be in place by 2020
- 2010 to 2025
    - Project development, environmental clearance, design, and construction for HOT lanes planned to be in place by 2025

Table 6: Keys to Reduced Project Development Time for HOT Lane Network

Factors That Can Reduce Project Development and Delivery Time	Topics on which agreement is needed
Agreement on HOT lane principles	• Governance • Use of revenues • Tolling principles
Agreement on HOT lane design standards and needed typical exceptions	• Whether to seek wide medians and ingress/ egress sections • Whether to pursue a simplified design approach
Agreement on project development approach, including agency roles and responsibilities	• What agency will lead the planning, environmental, design, and construction management tasks? • Which agencies will lead which tasks? • Will there be different roles played in different parts of the region? • To what extent will consultants be used?
Development of bonding approach	• Investment grade revenue forecast • Vetting of concept with financial institutions • Development of agreement on topics likely to introduce greatest uncertainty o Delivery schedule o Tolling principles o HOV occupancy requirements o Design standards o Safety

Appendix 1 – HOT Lane Sequencing Table

Appendix 1: Bay Are HOT Network Phasing Plan - Corridor Opening Sequence

Opening Year	I-680 Group		SC/SM Group		I-80 Group		Marin-Sonoma		I-880	
	Corridor	Comment		Comment	Corridor	Comment	Corridor	Comment	Corridor	Comment
By 2015 for demo projects	**Calveras** Note this includes: (a) ALA-680 SB SR 84 to ALA/SCL County line and (b) SCL-680 SB ALA/SCL County line to Calaveras.	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2035	**SR 85 SC**	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2020						
	I-580 ALA EB from Hacienda to Greenville	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2035	**SR 101 SC from San Mateo/Santa Clara Co line to Cochrane**	Begins HOT lane operation with HOV requirement at 2+; HOV occupancy increases to 3+ in 2035						
					I-80 ALA Central Ave (ALA Co line) to Bay Bridge Toll Plaza	Begins HOT lane operation at 3+ and stays at 3+ (test in 2nd scenario even though lane appears full)			**SR 84 (bridge approach)**	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2025
			SR 87 from US 101 to SR 85	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2040	**I-80 CC Carquinez Bridge to Central Ave (ALA Co line)**	Begins HOT lane operation at 3+ and stays at 3+ (test in 2nd scenario even though lane appears full)			**SR 92 (bridge approach)**	Begins HOT lane operation at HOV requirement of 2+; HOV lane requirement stays at 2+
			SR 237 I-880 to Mathilda	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2035					**I-880 ALA 16th St to merge with I-80 W**	Begins HOT lane operation at 3+ and stays at 3+
2015	**Calaveras.** Note this includes: (a) ALA-680 NB SR 84 to ALA/SCL County line and (b) SCL-680 NB ALA/SCL county line to Calaveras.	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2035	**I-880 SC from SR 237 to US 101**	Begins HOT lane operation with HOV requirement at 2+; HOV occupancy increases to 3+ in 2030	**I-80 SOL from Airbase Parkway IC to SR 12**	Begins HOT lane function at HOV occupancy of 2+ and HOV occupancy increases to 3+ in 2040			**I-880 ALA/SC Marina to SR 237**	Begins HOT lane function at HOV occupancy of 2+ and HOV occupancy increases to 3+ in 2025
	SR 4 CC from SR 160 to Port Chicago Highway	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2040	**SR 237 SC Mathilda to SR 85**	Begins HOT lane at HOV requirement of 2+ and HOV requirement goes to 3+ in 2035	**I-80 SOL thru Vallejo (Carquinez Bridge through SR37)**	HOV occupancy of 2+ with HOV occupancy increase at Carquinez bridge; HOV occupancy requirement increases to 3+ in 2040			**I-880 ALA 98th to Marina/Lewelling**	Begins HOT lane function at HOV occupancy of 2+ and HOV occupancy increases to 3+ in 2025
	I-680 CC from Benicia Bridge to Alcosta. Includes segments described as: Marina Vista to Alcosta (in E&F), N/O Waterfront (Benicia Bridge) to Alcosta (Connected Network); and NB segment between Rudyear and North Main (Connected Network)	Begins HOT lane operation when HOV lane requirement increases to 3+ in 2020	**US 101 SM Whipple to County Line**	Begins HOT lane function with HOV lane at 2+ and HOV goes to 3+ at 2035 due to SC 101 segment						
	I-580 ALA WB SJ Co to I-680	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2035	**I-280 SC from Magdalena to Leland Ave**	Begins operation with HOV lane at 2+ and HOV goes to 3+ at 2035						
	I-580 ALA EB Greenville to SJ Co	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2035								
	SR 4 CC from Port Chicago Hwy to I-680	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2040								
	SR4/I-680 CC HOV Connector Facility									
	I-680 ALA from Alcosta to SR 84	HOV requirement at 3+ due to adjoining segment of I-680 being at 3+								
2020	**I-580/I-680 ALA Connector**									
	I-680 SOL from I-80 to I-780	Begins HOT Lane operation with HOV lane requirement at 2+	**US 101 SC Cochrane to SR 25**	Begins operation with HOV lane at 2+ and HOV stays at 2+	**I-80 SOL from SR 37 to SR 12 and from Airbase Parkway to Yolo Co line**	Begins HOT lane operation with HOV requirement at 2+; HOV requirement increases to 3+ in 2040	**US 101 Marin SB 101/Seminary and NB 101/SR 1 to SR 37**	Begins HOT lane operation with HOV requirement at 3+		
	I-680/I-80 SOL Connector		**US 101 SM Whipple to Millbrae**	Begins HOT lane at HOV requirement of 2+ and HOV requirement goes to 3+ in 2040			**US 101 Marin SR 37 to San Antonio Road**	Begins HOT lane operation with HOV requirement at 3+ (5 years earlier than the HOV volumes would suggest going to 3+)		
			I-680 Calaveras to US 101	Begins HOT lane at HOV requirement of 2+ and HOV requirement goes to 3+ in 2035			**US 101 Sonoma San Antonio Road to Old Redwood Highway**	Begins HOT lane operation with HOV requirement at 3+ (5 years earlier than the HOV volumes would suggest going to 3+)		
2025			**I-280 SC from Leland to US 101**	Begins operation with HOV lane at 2+ and HOV goes to 3+ at 2035			**US 101 Sonoma Old Redwood Hwy to Windsor River Rd**	Begins HOT lane operation with HOV requirement at 3+		